The Drilling Habit of *Capulus danieli* (Crosse) (Mollusca : Gastropoda)

BY

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(Plate 7; 5 Textfigures)

In 1858, Crosse described Pileopsis danieli, a new species from the littoral waters of New Caledonia. In later pages of the same journal, he called it Capulus danieli and compared it with the well-known European Capulus ungaricus (Linnaeus). {Dall, 1889, p. 287, thought Capulus danieli was "almost certainly" Patella calyptra Martyn, 1784. However, the name is not available (Opinion 456, Int. Comm. Zool. Nomenclature) and the species came from the northwest coast of America.} Capulus danieli is smaller and higher than its cap-shaped European counterpart and its thin shell is a redder brown. The shining, white interior of the shell is usually flushed with rich reddish spots. The inherent sculpture is fine radial striae but the sedentary habit of much of its adult life induces the growth of gross, flexuous, radial ribs which correspond to those of its substrate, a common New Caledonian pecten, Comptopallium vexillum (Reeve, 1853). Capulus danieli is probably a protandric hermaphrodite like C. ungaricus.

While on a Natural Science Foundation - Academy of Natural Sciences Expedition, December and January, 1960-61, Mr. and Mrs. George F. Kline and the author, with the able help of Mr. Louis Devanbez of the South Pacific Commission, Noumea, dredged several examples of this uncommon Capulus from shallow water near Noumea, New Caledonia. Additional specimens were generously given to the Academy by Mr. and Mrs. André Lepelerie, of Noumea, who dredged the shells from the same area in April, 1959. In every case but one, Capulus danieli had bored a hole through the valve and mantle of its living "host", Comptopallium vexillum. Data on these specimens are summarized in Table 1.

Other members of the family Capulidae run the gamut from independent, ciliary feeders (some Capulus) to true parasites (Thyca). A wide variety of feeding habits may be observed within a single species. Capulus ungaricus, for instance, may attach to a dead shell or stone and spend its sedentary life filtering food from water drawn in by its own efficient ctenidium. Or, it may attach to the anterior-half margin of Chlamys opercularis (Linnaeus) where it benefits from the strong inhalant current set up by the scallop's larger gills. Sharman (1956, pp. 446-449) saw individuals of C. ungaricus notch the edge of the pecten valve by removing a piece of shell with the radula. On four occasions the proboscis was extended over the notched edge of the valve to pick food particles from between the margins of the pecten's velum. This tendency toward antagonistic symbiosis is furthered by the shell-boring and food-piracy habits of C. danieli.

The positions of drill-holes of Capulus danieli and of presumed capulid scars on their pecten "hosts" are illustrated in textfigure 1.

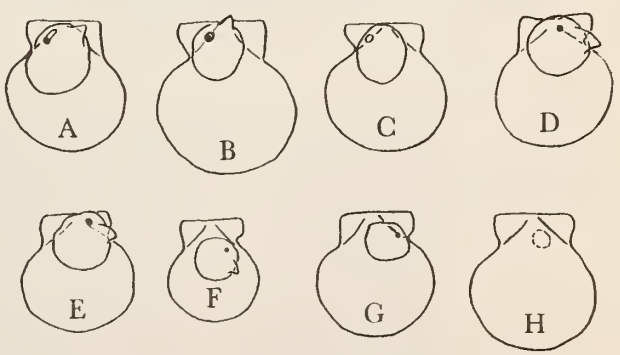

Figure 1: Diagrams of positions of *Capulus danieli* (Crosse) and their drill-holes on *Comptopallium vexillum* (Reeve). Specimens A to C and H on left valves, D to G on right valves. Letters correspond to those in Table 1. (x 0.2)

Table 1

(measurements in millimeters)

	Capulus danieli (Crosse)				*Comptopallium vexillum* (Reeve)			
Specimen	Station	Length	Height	Sex	Length[1]	Valve	Hole Diam.	Position
A	K 511	23.5	11.5	♀	42.0	Left	1.6	Anterior
B	K 511	18.8	9.5	♀	49.6	Left	1.9	Anterior
C	K 511	20.7	scar only		41.6	Left	2.5[2]	Anterior
D	K 511	18.1	10.2	♀	41.2	Right	1.8	Anterior
E	K 519	20.3	9.6	♀	38.6	Right	2.0	Anterior
F	31	13.8	5.9	♀	32.2	Right	1.9	Anterior
G	31	15.7	scar only		40.5	Right	1.5[3]	Anterior
H	31	7.9	3.6	♂	44.0	Left	none[4]	Posterior
I	K 510	20.7	10.5	dead shell, detached from peeten				
J	K 554	20.9	11.2					
K	K 508	22.8	12.5					

All collecting stations were near Noumea, New Caledonia. All collections were made by the Natural Science Foundation - Academy Expedition, except at station 31.

Station 31: about 26 feet, weed, Anse Vata Bay. 4 April, 1959. A. & M. A. Lapelerie leg.

Stations K 508, K 510, & K 511: 9 to 15 feet, sand and turtle grass. Anse Vata Bay. December, 1960 and January, 1961.

Station K 519: 36 feet, sand, weeds, 5 miles ENE Dumbea Pass, off Noumea. 20 Dec., 1960.

Station K 554: 20 feet, sand, weeds, Baie de L'Orphelinat. 14 January, 1961.

[1] antero-posterior [2] healed [3] open [4] "clean" area under *Capulus*, no signs of drilling

Although either right or left valve may be pierced, the hole is anterior and dorsal, over or near the pecten's mouth. The location of these holes, which give access to the highest concentration of food within the pecten's mantle cavity, is too uniform to be the product of chance.

An examination of the preserved soft parts of Capulus danieli and Comptopallium vexillum gives further clues to the nature of this symbiosis. The gut of the capulids was filled with loosely-formed fecal pellets, containing pieces of algae, sand grains, and mucus—characteristic of many ciliary feeders, including Comptopallium vexillum. One would expect less solid matter in the feces of a true parasite feeding upon flesh and fluids. Excepting the drilled hole through the mantle, the soft parts of four of the drilled pectens examined were intact and unscarred. Therefore, on the basis of uniformity of drill hole position and gut content of the Capulus and the absence of damage to the pecten's soft parts, this appears to be a case of antagonistic symbiosis, not true parasitism. The Capulus steals food from the labial palps and food-gathering tracts of the pecten.

A presumption is made that the hole through the pecten valve is drilled. This seems reasonable in the light of Sharman's observations mentioned earlier and the beveled nature of the hole. Unfortunately, none of the specimens collected were in the process of drilling and the

Explanation of Plate 7

Capulus danieli (Crosse) and *Comptopallium vexillum* (Reeve) from Noumea, New Caledonia.

Figure 1: Specimen "B" in situ on left valve of pecten. Figure 2: Side view of specimen "B" (x 3). Figure 3: Capulid scar and drill hole on left valve of pecten "B". Figure 4: Specimen "D" in situ on right valve of pecten. Figure 5: Side view of veliger from brood sac of *Capulus danieli*, specimen "A" (x 170). Figure 6: Part of radula, *Capulus danieli*, specimen "D" (x 160)

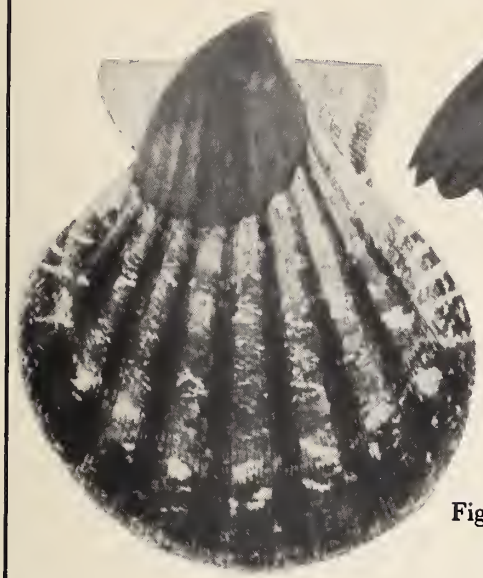

Figure 1

Figure 2

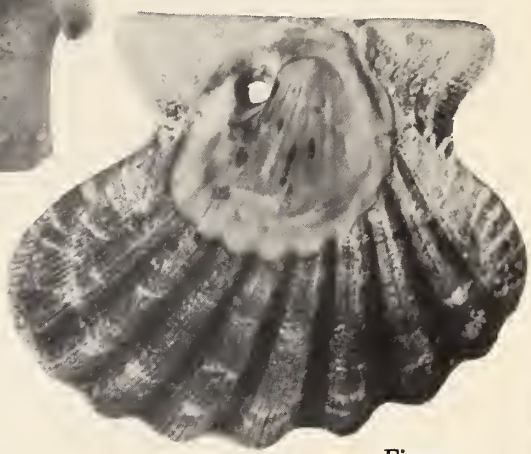

Figure 3

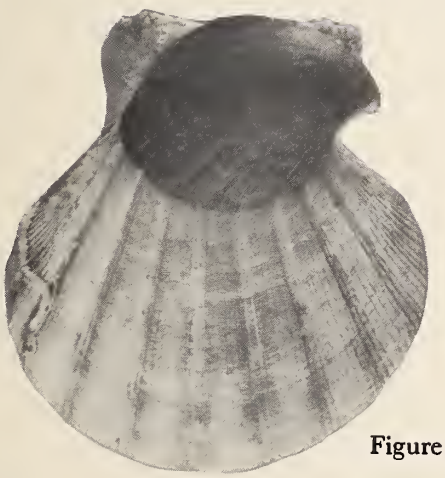

Figure 4

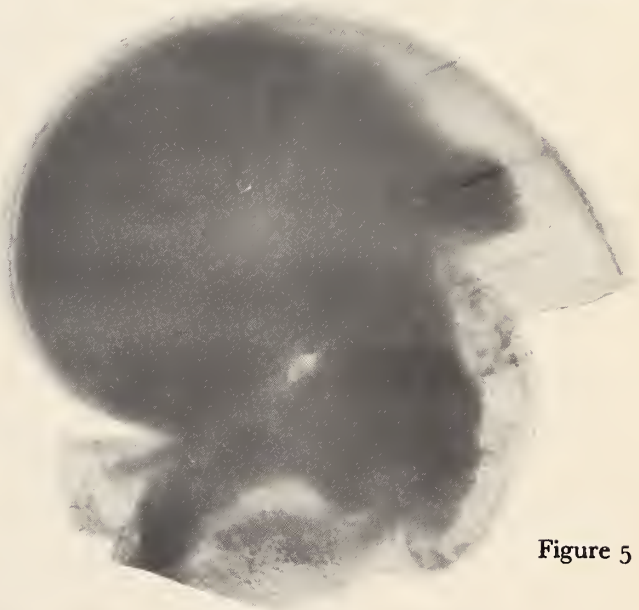

Figure 5

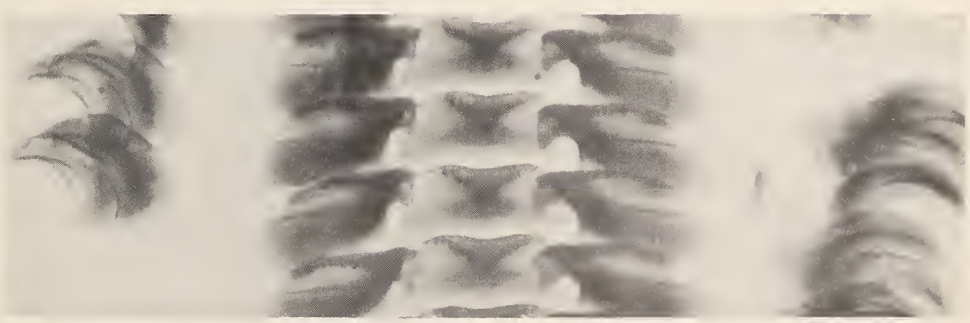

Figure 6

ORR, *photo*

radulae of five specimens examined showed only slight wear of the first three rows of teeth. The radula of an actively drilling specimen would probably show extensive wear.

The radula of specimen "D" is shown in Plate 7 and textfigure 5. This and the radulae of two other adult females had about 28 rows of hardened and about 8 rows of nascent teeth. That of the hermaphrodite specimen "H" had 20 hardened rows and 8 rows of nascent teeth. In specimen "H" the plates of the median and lateral teeth were slightly narrower but otherwise resembled those of the females.

Specimen "H" is particularly interesting because it is the only adherent Capulus danieli in our material which had not drilled. It is the only specimen attached to the posterior half of the scallop's shell, where it could not have benefited from the inhalant currents. Specimen "H" is, therefore, the only one of our New Caledonian capulids which was an independent ciliary feeder. It is also the only one which did not have the anterior third of its shell clogged by a brood sac of developing eggs or veligers.

Figure 2: Dorsal view of head of *Capulus danieli* (Crosse), specimen H, showing atrophied verge v. (x 8.0)

Yonge (1938) has shown that in the closely-related species Capulus ungaricus, food brought in by the inhalant current gathers in mucus-laden masses on the upper surface of the propodium, where it is picked up by the long, grooved proboscis and ingested. The efficiency of the current and food-gathering area must be impaired by the brood sac, which in C. danieli is also attached to the upper surface of the propodium.

In textfigure 4, the brood sac (bs) has been pushed down and to the left to show the capulid's head and proboscis (p). In all five preserved females examined, the head and most of the proboscis were buried in a hollow of the sac. The tip of the proboscis was folded posteriorly along the snail's right margin. This differs sharply from the position of the hermaphrodite capulid "H" shown in textfigures 2 and 3. The

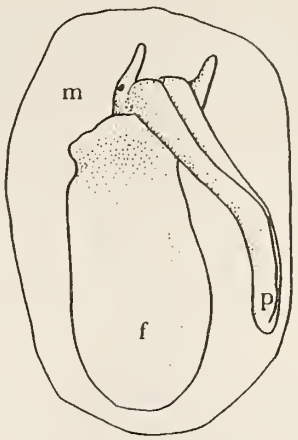

Figure 3: Ventral view of *Capulus danieli* (Crosse), specimen H; p - grooved proboscis, f - foot, m - mantle. (x 4.0)

position of the female's proboscis bent posteriorly along the right side explains the peculiar position of the drill-hole, especially if the hole is drilled after egg-laying commences.

The duration of the egg-laying and brooding period is not known. Females with relatively undeveloped eggs and those with well-developed veligers (Plate 7, Fig. 5) were collected both April 4, 1959 and late December, 1960. The veligers of specimens "A" and "F" had well-developed eyes and a velum which appeared to be bilobed, with lateral indentations on each lobe not unlike the velum of Capulus ungaricus (Lebour, 1937). However, the method of our capulid veligers' preservation, within the brood sac and in 70% grain alcohol, precluded detailed study. It was not possible to determine whether Capulus danieli veligers are echinospira as are Capulus ungaricus.

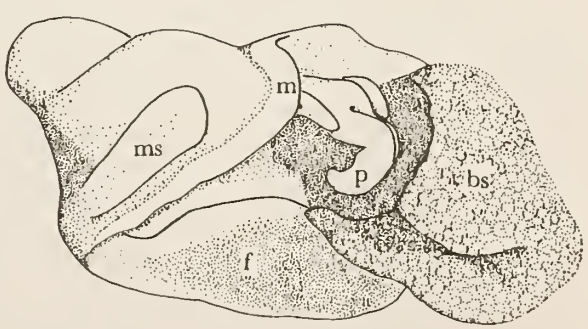

Figure 4: Side view of *Capulus danieli* (Crosse), specimen A; bs - brood sac, ms - mantle scar, other letters as in Figure 3. (x 1.2)